JPRS 71925

25 September 1978

USSR

TRANSLATIONS ON USSR SCIENCE AND TECHNOLOGY

BIOMEDICAL AND BEHAVIORAL SCIENCES

No. 46

U. S. JOINT PUBLICATIONS RESEARCH SERVICE

NOTE

JPRS publications contain information primarily from foreign newspapers, periodicals and books, but also from news agency transmissions and broadcasts. Materials from foreign-language sources are translated; those from English-language sources are transcribed or reprinted, with the original phrasing and other characteristics retained.

Headlines, editorial reports, and material enclosed in brackets [] are supplied by JPRS. Processing indicators such as [Text] or [Excerpt] in the first line of each item, or following the last line of a brief, indicate how the original information was processed. Where no processing indicator is given, the information was summarized or extracted.

Unfamiliar names rendered phonetically or transliterated are enclosed in parentheses. Words or names preceded by a question mark and enclosed in parentheses were not clear in the original but have been supplied as appropriate in context. Other unattribute parenthetical notes within the body of an item originate with the source. Times within items are as given by source.

The contents of this publication in no way represent the policies, views or attitudes of the U.S. Government.

PROCUREMENT OF PUBLICATIONS

JPRS publications may be ordered from the National Technical Information Service (NTIS), Springfield, Virginia 22151. In ordering, it is recommended that the JPRS number, title, date and author, if applicable, of publication be cited.

Current JPRS publications are announced in Government Reports Announcements issued semimonthly by the NTIS, and are listed in the Monthly Catalog of U.S. Government Publications issued by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

Indexes to this report (by keyword, author, personal names, title and series) are available through Bell & Howell, Old Mansfield Road, Wooster, Ohio, 44691.

Correspondence pertaining to matters other than procurement may be addressed to Joint Publications Research Service, 1000 North Glebe Road, Arlington, Virginia 22201.

BIBLIOGRAPHIC DATA SHEET	1. Report No. JPRS 71925	2.	3. Recipient's Accession No.
4. Title and Subtitle TRANSLATIONS ON USSR SCIENCE AND TECHNOLOGY BIOMEDICAL AND BEHAVIORAL SCIENCES, No. 46			5. Report Date 25 September 1978 6.
7. Author(s)			8. Performing Organization Rept. No.
9. Performing Organization Name and Address Joint Publications Research Service 1000 North Glebe Road Arlington, Virginia 22201			10. Project/Task/Work Unit No. 11. Contract/Grant No.
12. Sponsoring Organization Name and Address As above			13. Type of Report & Period Covered 14.

15. Supplementary Notes

16. Abstracts

The report contains information on aerospace medicine, agrotechnology, bionics and bioacoustics, biochemistry, biophysics, environmental and ecological problems, food technology, microbiology, epidemiology and immunology, marine biology, military medicine, physiology, public health, toxicology, radiobiology, veterinary medicine, behavioral science, human engineering, psychology, psychiatry and related fields, and scientists and scientific organizations in biomedical fields.

17. Key Words and Document Analysis. 17a. Descriptors

USSR	Medicine
Aerospace Medicine	Microbiology
Agrotechnology	Physiology
Biology	Psychology/Psychiatry
Botany	Public Health
Epidemiology/Immunology	Radiobiology
Human Engineering	Toxicology
Marine Biology	Veterinary Medicine

17b. Identifiers/Open-Ended Terms

17c. COSATI Field/Group 2, 5E, 5J, 6, 8A

18. Availability Statement	19. Security Class (This Report)	21. No. of Pages
Unlimited Availability Sold by NTIS Springfield, Virginia 22151	UNCLASSIFIED	
	20. Security Class (This Page) UNCLASSIFIED	22. Price

JPRS 71925

25 September 1978

TRANSLATIONS ON USSR SCIENCE AND TECHNOLOGY

BIOMEDICAL AND BEHAVIORAL SCIENCES

No. 46

CONTENTS PAGE

AGROTECHNOLOGY

UDC 636.22/.28.084.522

OPEN LOT FACILITY FOR CATTLE FATTENING

Moscow ZHIVOTNOVODSTVO in Russian No 6, 1978 pp 55-59

[Article by Moskalevskiy Sovkhoz (Kustanayskaya Oblast) Director M. G. Karpov, deputy to Kazakh SSR Supreme Soviet; Candidate of Agricultural Sciences G. V. Shesterin, All-Union Institute of Livestock Raising; and Moskalevskiy Sovkhoz Chief Zootechnician Z. A. Zhanburshinov: "Experience of Fattening Cattle on Open Lot on Moskalevskiy Sovkhoz, Kustanayskaya Oblast"]

[Text] In the current five-year plan, the country plans to raise average annual meat production to between 15 and 15.6 million tons slaughter weight, chiefly by increasing beef production. In this connection, plans call for further developing specialized cattle raising for meat.

In recent years, all livestock farming has been intensively converted to an industrial basis in Kazakhstan. Systematic and essential increases in grain production are leading to an expansion of plowed farmland and, as a result, to a reduction of areas of natural feed lands such as pastures and hay fields. Intensification of feed production and a slight rise in the cost of the feeds oblige us to find additional reserves for boosting livestock productivity and labor productivity in beef production.

These reserves are to be found, on the one hand, in fuller utilization of the potential capabilities of livestock productivity of Soviet and imported meat breeds and, on the other hand, in further development of on-farm specialization and intensification of livestock raising and fattening.

To resolve these tasks, specialists of Moskalevskiy Sovkhoz are making extensive use of cross breeding and intensive fattening of young stock. In 1971 the farm designed and built a specialized lot to raise and fatten young stock. Six years of operation of the lot have shown that it was the correct way to improve the effectiveness of stock raising and fattening, to boost livestock farmer labor productivity, and to raise profitability in livestock meat farming.

The lot was built out of local materials, with low capital investment. Any farm having sufficient cattle to fatten is up to the task of building such a lot.

In layout, it is a rectangle of 100 by 150 meters. Around the perimeter is an enclosed overhang (made of side pieces) with a slate roof (see figure). The overhang is six meters wide. In addition, the outside of the lot is protected against the wind by a fence made of sidepieces, 2.7 meters high. Inside, the lot is divided into 12 sections--6 sections on a side with a passageway in the center. Each section accommodates 100 to 110 head. The passageway is 10 meters wide. This makes it possible for a tractor or truck to maneuver with additional attached equipment.

The dividers which form the sections are feed troughs for silage and concentrates, also watering basins. Above the feed troughs, additional wooden poles are attached to prevent the animals from passing between sections. The feed troughs are made of large-diameter metal pipes cut lengthwise. They are rather strong and wide and allow feeding from both sides at once (one row of feed troughs for every two sections). The watering pans (basins) are made of welded sheet steel, rectangular in shape. The basins are equipped with electric heaters. Watering is automated, and the capacity of a group basin is 300 liters. There are a total of 10 watering basins--5 on each side; this takes care of the watering needs of all of the cattle being fattened.

[Figure not reproduced]

Layout of Fattening Lot Accommodating 1,200 Head on Moskalevskiy Sovkhoz: 1--wind fence; 2--enclosed space with deep bedding; 3--livestock sections; 4--feed troughs for succulent and concentrated feeds; 5--mobile feeder for coarse feeds (hay, straw); 6--automatic watering basin with water heater; 7--loading platform; 8--service room; 9--disinfection barrier.

Each section has a mobile feeder for hay or straw, mounted on runners. The feeders can hold 1.7 tons of coarse feeds. All loading, delivery, and dispensing of feeds and removal of manure are fully mechanized. In order to supply uninterrupted feeding to the animals and maintain cleanliness, the following mechanisms and equipment are installed in the lot: an MTZ-50 tractor (to deliver straw and hay); a T-75 tractor with a mounted scoop (to remove snow and manure from the area); a ZIL-157 vehicle coupled with a KTU-10 feed dispenser (to deliver and dispense silage); and a GAZ-53 vehicle hooked up with a KUT-3 feed dispenser.

Deep permanent bedding is laid in the space under the overhangs; in bad weather the cattle can freely move under the overhangs. There is no bedding in the sections.

The animals are cared for (1,200 head) by four livestock machinery operators who have completely mastered the techniques and equipment. Their wages are based on the amount of increase and the quality of the goods produced.

The construction, equipping, and technology required only 68,800 rubles; this comes to 57.3 rubles per head. The feeding and the placement of the animals by sections is handled on the basis of their live weight. The fattening period lasts from 100 to 120 days, sometimes more; this depends on the weight and age of the animals, the quality of the feed, and so on. On reaching a weight of 450 to 460 kg, the castrated animals are taken from the lot and shipped by truck to the meat combine.

An essential condition for intensifying beef production in livestock raising for meat is that of obtaining animals of vigorous growth and capable of utilizing local, inexpensive feeds effectively. This problem is resolved by double- and multiple-breed industrial cross breeding. The resulting crosses are distinguished by better growth rate, vigor, and good feed utilization. Investigations by VIZh [All-Union Scientific Research Institute of Livestock Raising], VNIIMS [All-Union Scientific-Research Institute of Butter and Cheese Industry], and a number of other scientific institutions, also the experience of the Moskalevskiy Sovkhoz in Kustanayskaya Oblast, Yubileynyy Sovkhoz in Omskaya Oblast, Kalininskiy Sovkhoz in Chelyabinskaya Oblast, and many others demonstrate the high effectiveness of raising cross breeds for meat. Above-replacement young stock raised on these farms reach high slaughter conditions with an average weight of 450 to 550 kg by the age of 15 to 18 months, with feed outlays of 6.5 to 8.0 feed units per kg of gain, and livestock raising for meat as a sector is highly profitable.

Moskalevskiy Sovkhoz has accumulated considerable experience in producing and raising double- and triple-breed crosses from Kazakh white-head, Charolais and Aberdeen-Angus. Cross breeding animals to get double and triple breed crosses, and then crossing them, makes it possible over the long run to maintain the heterosis effect in the herd and to make good use of it to increase beef production. Experimental research conducted on Moskalevskiy Sovkhoz by VIZh has shown that crossbred animals are 7 to 10 percent more effective in feed utilization and 10 to 15 percent more productive. Moreover, the meat quality is better.

Moskalevskiy Sovkhoz initiated the fattening of beef cattle on a specialized fattening lot with industrial production technology. This gave a boost to the broad dissemination of this kind of cattle fattening. Many farms in Kazakhstan, making use of the Moskalevskiy experience, have organized such fattening lots and are operating them successfully. The full mechanization of production processes built into the technology makes it possible to substantially reduce labor and resource outlays and to boost animal productivity, also to boost labor productivity sharply and reduce gain prime cost.

A comparative analysis of the results of intensive fattening of young stock on a specialized feed lot and the traditional method of stock raising (using the Moskalevskiy Sovkhoz as the example) has demonstrated the high economic effectiveness of lot fattening.

Labor outlays to produce one quintal of live weight were reduced by 40 percent; feed outlays were reduced by 30 percent; live weight production per man-hour was increased by 1.7 times, while profits rose by two times. Feed consumption per kilogram of live weight gain was reduced by three feed units, and the prime cost per quintal was reduced by 30 percent.

To organize intensive fattening operations, prime importance attaches to supplying the animals with full-nutrition feeds for the entire period. A strong feeds base and the availability of feeds produced on the farm itself constitute the main lever for intensifying beef production. For this reason, farms converting to the industrial technology of fattening must above all weigh their feed production capabilities and organize them so as to provide all of the animals' needs.

In the Ninth Five-Year Plan, the Moskalevskiy Sovkhoz fattened and sold to the state 5,700 head weighing 26,020 quintals. The average delivery weight over the five years was 456 kg, and in recent years all of the livestock sold have been of top nutrition. Some batches of fattened young stock weigh even more. In the first quarter of 1977, for example, the lot delivered a batch of crossbred castrated animals, 290 head in all, weighing an average of 530 kg.

Labor productivity on Moskalevskiy Sovkhoz has risen sharply. The workload per worker has risen to 300 animals--that is, a factor of 4 to 5 compared with the former technology of raising and fattening young stock. The production of live cattle weight per worker in 1976 was 421 quintals. Beef production profitability on the fattening lot reached 200 percent. Outlays on the construction and equipping of the fattening lot were recovered in two months.

Since the start of cross breeding operations, the number of cattle sold to the state has increased by 3.4 times (from 906 to 3,146 head), and the weight has risen by more than 4.5 times. During this period, the average delivery weight per animal has risen from 334 to 465 kg; in the Ninth Five-Year Plan the average delivery weight was 456 kg--that is, an increase of 40 percent. Putting the technology into operation made it possible to boost labor productivity in stock fattening. Thus, liveweight production per worker rose from 191 quintals in 1971 to 421 quintals in 1976--that is, a factor of more than 2.2. At the same time, the quality of the production improved. In 1971 each worker accounted for product sales totaling 38,391 rubles; in 1976 the figure was 91,952 rubles, an increase of 2.4 times. The farm is getting additional substantial income for delivering high quality stock. In 1976, for example, more than 245,000 additional rubles were earned. The lot's daily yield is 1.5 tons of high-quality gain.

The basic technical-economic indicators of the fattening lot's operations on Moskalevskiy Sovkhoz in the six years are shown in the following table:

Technical-Economic Indicators of Fattening Lot on Moskalevskiy Sovkhoz

[Figure not reproduced]

Key:

1. Indicator
2. Year
3. Removed from fattening (head)
4. Length of fattening period (days)
5. Average live weight per animal when placed in lot (kg)
6. Average live weight per animal when removed from fattening (kg)
7. Live weight gain per animal (kg)
8. Average daily live weight gain (grams)
9. Feed consumption per kg of live weight gain (feed units)
10. Labor outlays per quintal of gain (man-days)
11. Prime cost per quintal of gain (rubles)
12. Top-nutrition stock sold (percent)
13. Selling price per quintal of live weight (rubles)
14. Profitability of live weight production (percent)

At present, each kilogram of gain takes an average of 9.7 to 10.4 feed units. For this reason, the sovkhoz's farmers face the urgent task of reducing these outlays in the near future. Six years of experience in feeding cattle on an open type lot have shown that feed consumption per unit of gain rises 20 to 25 percent with the onset of persistent cold weather, because during that period the proportion of concentrated feeds in the diet rises, and in addition consumption rises; consequently, the cost of weight gain in the winter is higher. But these outlays (when feed is available) are more than made up by the excellent rate of growth of crossbred animals and high labor productivity; the seasonal nature of stock delivery is leveled out, and beef production becomes more rhythmical.

The feeding of straw-concentrate granules made in the sovkhoz's feed shop is helping to make winter weight gain less expensive. These granules include straw (40 to 50 percent), concentrates (40 percent), hay and conifer meal, and vitamin and mineral additives. Unfortunately, the feed shop's equipment

productivity so far is not able to meet all of the granule needs of the stock being fattened. For this reason, granulated feed is given only on those days when the animals are given corn silage in cold weather.

It has been found that the sovkhoz's double- and triple-breed crosses, also crosses of triple-bred hybrids, have passed the stiff test of untethered, large-group maintenance in sections of an open fattening lot (in the winter and summer conditions of North Kazakhstan); they have demonstrated high vigor and at the same time maintained their ability to grow rapidly and make effective use of large-quantities of coarse and succulent feeds.

In the near future, all of the livestock on Moskalevskiy Sovkhoz to be sold to the state will be raised and fattened on the lot. For the purpose, the farm is building another fattening lot to accommodate 2,400 head.

6854
CSO: 1870

AGROTECHNOLOGY

631.15:33]:636.4(47+57)

KAZAKH INTERFARM HOG RAISING COMPLEX

Moscow ZHIVOTNOVODSTVO in Russian No 6, 1978 pp 75-78

[Article by Velikiy Oktyabr' Interfarm Hog Raising Complex Director G. M. Serikov (Buturlinovskiy Rayon, Voronezhskaya Oblast): "Work Experience of Interfarm Hog Raising Complex"]

[Text] The Velikiy Oktyabr' Interfarm Hog Raising Complex in Buturlinovskiy Rayon, Voronezhskaya Oblast, was set up in 1968 through the shared funds of 21 kolkhozes and 2 sovkhozes, and was built according to a design made by local specialists. The projected capacity of the complex is 6,500 tons of pork per year. At present, it is one of the largest specialized hog raising farms using an industrial production technology.

The enterprise has a strong material-technical base. It has 35 production facilities in operation to maintain the hogs. In addition, there are buildings for making feeds and storing and repairing vehicles and other machinery.

The complex has introduced precise on-farm specialization and separate-shop organization of labor. All production is alloted among five shops.

The enterprise has a combination feeds plant capable of producing 70 tons per shift, blocked together with five grain warehouses holding 30,000 tons, a feed making shop, a mechanical shop, a garage, an underground fuel and lubricants storage facility with a filling station, a boiler facility, a decontamination center, and an administrative building accommodating the offices, a club, and a cafeteria. There is also a complex of mechanisms, structures, and conduits to remove and hold manure.

The farm produces pork continuously on the closed-cycle principle. At present the technology in use makes it possible to produce 65,000 quintals of pork per year. The complex makes extensive use of fixed sow maintenance and battery raising of the piglets; this makes it possible for two operators to care for 3,400 gilts. The present technology makes it possible to raise hogs weighing an average of 100 kg in seven months.

The operators work in two shifts, seven-hour days and six-day weeks; wages paid to service personnel are based on production output.

To manage production-financial activities, a shareholder farms council has been set up; its members are elected at the general meetings of the kolkhozes and sovkhozes of the rayon. The council chairman is the director of the complex. The council examines and approves the production-financial plan, the annual report, and the documents of the audit commission, and handles other problems relating to the activities of the inter-farm enterprise; it appoints the director and the main specialists; it chooses a board of directors to handle routine production problems. The complex has its own balance sheet, current and other accounts in Gosbank, and has the rights of a legal entity.

Construction of the interfarm hog raising complex required the investment of 13.8 million rubles, of which state credits constituted only 20 percent. Since it has been in operation, it has earned 26.0 million rubles in profit; the capital investment recovery amounts to 166 percent.

Production ties in the organization of interfarm enterprises are complex and various, and for this reason it is important to work out the correct economic interrelationships between the shareholding farms and the complex, because these constitute the conditions for successful operation. The basis of economic relations between shareholding farms and the complex comprises contractual obligations which create equal conditions for all farms taking part in the joint operation, as follows.

The hog raising complex is set up on the basis of shareholder farm funds, which are contributed equally on the basis of the number of hectares of plowed land; for the period of development of the reproductive shop, the young hogs are purchased on a contractual basis on the kolkhozes and sovkhozes on the basis of prices which are differentiated according to the age and live weight of the animals; the hogs are raised on feed delivered to the shareholding farms by contract, and the complex pays on the basis of state purchase prices; the costs of delivering the hogs and the feeds are borne by the complex; earned profit and realized animal increase are distributed to the shareholding farms proportionally to feeds supplied.

In this way, the basis of the cooperative operation comprises contractual obligations with respect to feed deliveries. These economic relations have been successfully in force since 1969; they encourage the kolkhozes and sovkhozes to increase feed production.

In order to ensure an equal profitability level to the farms engaged in young stock raising and fattening, the following differentiated prices for purchased young stock have been set:

Average live weight per head (kg)	Price per quintal of live weight (rubles)
22--25	228
26--30	214
31--35	196
36--40	189
41--45	177
46--50	163
over 51	144

The shop organizational structure works well with the continuous production technology; this simplifies the management of economic activities, because the main operation is headed by chief specialists (they are shop chiefs), through whom the board of directors organizes and controls production.

The farm is introducing the flow-line method of continuous production--that is, it calls for daily stock increase, also transition from younger groups to older ones and the delivery of fattened hogs to the meat combine.

The first phase of the construction of the complex became operational in September 1968; the first year of industrial fattening operations showed that the chosen path was the correct one, and the creation of interfarm enterprises to produce livestock products has a great future.

Already in 1969, 21,700 quintals of pork were sold to the state and the complex managed to achieve an average daily weight gain of 442 grams, with 6.3 quintals of feed units for every quintal of gain.

The level of production is rising constantly, and quality indicators are improving. During the entire period of operation of the interfarm enterprise, 450,000 head of hogs have been sold, with a total live weight of 486,000 quintals.

The average daily gain in 1977 was 495 grams; the gross live weight increase was 63,025 quintals.

The production of piglets is increasing each year. In 1970 the reproductive shop raised 19,000 piglets; in 1976 it had risen to 32,000; each brood sow produced 20 piglets with an average live weight of 7.6 kg when weaned at the age of 35 days, with a per-piglet cost of 22 rubles.

Experience showed, for example, that further efforts to improve the technology of raising and fattening piglets would not have the desired success as long as there was a shortage of succulent and vitamin-enriched feeds in the diet. In April 1972, therefore, Druzhba Kolkhoz turned over 2,354 hectares of plowed land to meet all of the enterprise's grain, succulent, and vitamin-enriched feed requirements from its own production.

In the technology of pork production, great importance attaches to the feed making service, which handles procurement, storage, and processing for stipulated diets, also deliveries to places of consumption. In the complex, all processes of making combination feeds--from receiving the grain to loading it onto the transport vehicles--are fully mechanized. Local experts managed to raise the capacity of the combination feeds shop from 15 to 70 tons per shift without increasing the number of service personnel; this yields substantial economic effect. Formerly, 21 kolkhozes of Buturlinovskiy Rayon had 95 workers making feeds; now the shop employs only 14. The cost of producing one ton of combination feeds in 1977 came to 4.41 rubles.

It must be pointed out that the successful implementation of the technology of industrial pork production has been largely facilitated by providing excellent specialist and worker cadres for the complex.

The average roster number of workers engaged in the complex's production processes is 347; there are 169 in the feed production shop. In all, the complex employs 516 workers and specialists.

Socialist competition plays an important role in organizational-mass work. In order to improve the effectiveness of competition, extensive use is mad made of moral and material incentives. The use of various kinds of labor indoctrination of workers in the collective reduces annual cadre turnover and improves labor discipline.

The complex has study circles designed to upgrade production qualifications and educate the workers in economics. There are remarkable workers in the shops and production links, true masters of their craft. Thus, excellent production results were achieved in 1976 by hog fattening operators M. F. Kostomarova and M. P. Polyakova, who achieved an average daily gain of 535 grams per animal. Feed consumption per quintal of gain in their group came to 5.2 quintals of feed units, and gross live weight gain amounted to 5,775 quintals; 6,104 quintals of pork were sold to the state, with an average live weight of 118 kg per animal.

At present, the inter-farm complex accounts for more than 80 percent of state pork purchases in the social sector of Buturlinovskiy Rayon. Before the complex was set up, kolkhozes in the rayon sold the state 18,000 quintals of pork; in 1977, the complex alone sold 75,400 quintals. Moreover, the prime cost of producing one quintal of pork declined by 1.6 times, totaling 67.9 rubles, and the live weight gain of the hogs in the fattening process amounted to 55.2 rubles. Labor productivity rose by 20 times, and feed consumption per quintal of gain declined by two times; labor outlays necessary to produce one quintal of pork in the complex at present come to 3.48 man-days, including only 1.9 man-days in the fattening operation; each workers accounts for more than 20 tons of pork. In 1977, the specialized farm's profits totaled more than three million rubles, of which the shareholding farms received 3.0 million rubles; before the complex was created, the kolkhozes of the rayon received only 488,000 rubles in profit from hog raising--six times less.

Interfarm production cooperation in Buturlinovskiy Rayon, as in other rayons of the oblast, is based on voluntary principles and is accessible to all of the farms. For economically weak farms, moreover, it is one of the best ways to strengthen their economies, because the benefits from the activities of interfarm enterprises are enjoyed equally by all of the farms taking part in the operation.

The complex is doing a certain amount of work designed to convert to the meat type of hog fattening. Considering local conditions, this task can be resolved in two ways. First, convert to supplying the complex's own reproductive shop with double-breed brood sows and organize artificial insemination with semen from meat breeds of boars so that young stock to be fattened will result from triple-breed crossing and possess the heterosis effect.

Secondly, by changing the quality composition of the feed components plans call for changing the ingredients of the complex's own combination feeds output, designed to produced high average daily gains and result in excellent meat quality.

In the structure of feed crop cultivation, the shareholding farms plan to increase the amount of land sown to peas and increase deliveries of peas to the complex to 15 to 20 percent (8 to 10 percent in the case of oats) of grain feed requirements.

Calculations of various feed ingredient requirements are made in accordance with the recipes of the All-Union Scientific-Research Institute of Combination Feeds Industry. Moreover, recipes have been drawn up which, in most cases, can be made up from the farms' own materials.

To produce the required amount of combination feed (36,500 tons) requires 33,400 tons of fodder grain, to be delivered by the shareholding kolkhozes. The complex pays the cost of the delivered feeds to the shareholding farms on the basis of state purchase prices.

For purposes of providing all the necessary green, succulent, and vitamin feeds our complex has more than 500 hectares of perennial grasses. In the future, plans call for expanding the areas planted to these grasses to 1,000 hectares in order to produce high-quality vitamin enriched grass meal, the output of which in the current five-year plan is to be increased from 1,800 to 3,000 tons per year.

The complex's veterinary service is organized on the production-shop principle, and it has a decontamination center for the service personnel and the vehicles, a slaughtering facility when animals need to be killed, two DUK vehicles, and a crematorium for dead animals. The veterinary service is divided into two sections (the reproductive and the fattening shops) headed by senior veterinarians.

In addition to local processing, animals brought from other farms for fattening are subjected to secondary associated vaccination against cholera, erysipelas, and (Auyeski) disease. Associated vaccination is also used on the reproduction farm complex. Strictly according to schedule and every time after the hogs are moved, the facilities are disinfected and the animals are disinfested, deratted, bathed, and dehelminthized.

In must be pointed out that in the production activities of the complex we encounter problems which must be resolved with the participation of higher-level agencies. In order to economize on feeds, for example, it is now necessry to supply interfarm enterprises having their own combination feeds shops and plants with protein and vitamin additives and premixes. In addition, interfarm enterprises have been in existence for more than 10 years, but so far no uniform recommendations have been made with respect to wages paid to workers and specialists.

Interfarm enterprises also need uniform accounting and report forms.

Continuous production can succeed as long as there is a reserve of material-technical resources or else technical service to the enterprises by organizations of Sel'khoztekhnika is properly organized. At present, however, neither case obtains.

It must be pointed out that electrical devices now being turned out by industry to provide air ventilation in production facilities do not last long in operation and are not designed for high efficiency. For this reason, it is essential that designers and scientists cooperate with production workers to produce fans of stronger design that are simple and reliable to operate.

In order to lengthen the service life of the equipment in livestock raising facilities, it is essential to develop strong anti-corrosion coatings and put them to use.

Prompt solutions to these problems by the appropriate ministries and departments will make it possible to achieve lower costs and a faster pace in implementing the program of converting livestock production output to an industrial basis within the framework of interfarm cooperation and agroindustrial integration.

6854
CSO: 1870

PSYCHOLOGICAL ASSESSMENT OF DIFFERENT LEVELS OF TENSION

Moscow TEKHNICHESKAYA ESTETIKA in Russian No 5, 1978 pp 6-9

[Article by L. V. Kashirina, Graduate Student, All-Union Scientific Research Institute of Technical Esthetics]

[Text] Recent research on functional states arising during performance of various forms of operator activity has shown that the state of tension, the dominant functional state, contains within itself all transitory forms of human activity included within labor (1), and that differentiated assessment of this state would permit us to objectively assess the individual's functional capabilities.

Success in monitoring the dynamics of functional states which are the product of high responsibility for the reliability of man-machine systems (2) depends on the sensitivity of the psychophysiological instruments used to quantitatively assess transitory forms of activity. Associated with this problem is further development of its theoretical aspects, especially development of adequate and informative resources with which to penetrate into the psychophysiological structure of a functional state.

Interest has risen significantly in the functional states problem in recent works (3,5,6). Scientists are actively searching for efficient, effective resources with which to assess their dynamics (7,8). Attempts are being made to introduce the most sophisticated technical resources into experiments (3) so that the level of a functional state could be determined with greater differentiation (4). Further success in development of these directions of research on functional states in engineering psychology and ergonomics will depend primarily on the sophistication, adequacy, and immanency of the resources selected to assess the psychophysiological content of the phenomenon under analysis; moreover it is important to represent the latter scientifically, assess it experimentally, and quantitatively measure it if required, and differences in changes experienced by its characteristics must be established.

In regard to functional state and its most significant variant--the state of tension, we must assume the general approach of revealing

the structural content of the phenomenon under analysis (4,12). This approach is based on the need for finding the most radical scientific experimental resources, considering that we are in a time of accelerated assimilation of achievements in the scientific-technical world, and for implementing them to solve many practical problems associated with research on human factors (9).

Engineering psychology and ergonomics are developing in accordance with the requirements and demands of scientific-technical progress. This is why the experimental resources and the working tools of this sector of knowledge must correspond to the state of modern science, so that its basic achievements could be utilized. This approach to studying human factors pertains to all problems in ergonomics, including the problem of functional states.

It was in this connection that I attempted to assess levels of tension with the help of modern highly sensitive electrophysiological resources used mainly in research on the physiology of higher nervous activity.

As we know, research on the state of tension has its own history (10,11, 12, etc.). But until recently the qualitative aspect prevailed in such research, mainly with the goal of revealing the determinant of the state of tension. The psychophysiological aspect entered into the picture only as the necessary internal condition. The goal of revealing the basic psychophysiological properties of functional states--variability and dynamics (5) from a quantitative point of view--was not posed. At the same time the state of tension viewed as a continuum of levels of activity of the central nervous system reflects the most important properties of functional state, its variability associated with the dynamics of the activity itself (13). This point of view is based on the conceptions of V. Block, D. Lindsley, and G. Moruzzi on the levels of wakefulness and the levels of nervous activity (14).

When we make a differentiated assessment of the state of tension, we must establish the relationship between previously determined forms of tension and the levels of activity or the functional states of the brain using bioelectric indices. This form of assessment permits us not only to find a quantitatively expressed indicator of change in the form of tension, but also to approach the psychophysiological mechanism itself at the basis of this change. Use of EEG indices in these tasks is based on M. I. Livanov's conception that spatial mutual relationships of bioelectric activity change depending on different functional states of the brain (15). Research by Livanov's school has shown that during performance of one assignment or another long, stable changes in the level of activity, lasting dozens of seconds, arise in certain zones of the brain (in the cortex and in subcortical structures); these levels can be described as functional states of the brain, correlated with specific features of the activity being performed--speed, complexity, attitude toward this activity, and so on.

The basic goal of the present work was to demonstrate the effectiveness of using a rather complex but highly sensitive experimental resource, the EEG method, for differentiated assessment of the state of tension, the dominant functional state of a working individual. Not only the successfulness of the activity and its reliability but also development of efficient resources for its optimization depend on our knowledge of the transitory forms of this state, on our ability to assess them.

The choice of the test factor causing change in levels of tension predetermined the experimental conditions, the sort of subjects used, the type of operational mental activity, and the range of changes in functional state.

The research was conducted during occupational expert examination of a uniform group consisting of 29 subjects. The subjects performed a mandatory standard assignment having the objective of revealing functional potential for errorless work; the results were used to assess occupational suitability. This assignment was the "Ioseliani test" (16). It involved change in rate of operational mental activity in detection mode coupled with delayed servicing, where the intermediate link between signal perception and the response is arithmetic using numbers within 10--addition or subtraction depending on the color of the digit. The subject had to calculate continuously, retaining in his memory the result of these operations and changing it when a new digit was presented.

Thus in terms of structure the activity involves retention of the initial number in the memory, recognition of a new number, decision making (red--addition, green--subtraction or vice versa) and a vocal response following a sign from the experimenter (after every 10-12 arithmetic operations).

Change in the rate of activity was elicited by introducing different temporal conditions--a time limit, and too little and too much time for the arithmetic operations. As we know, (10), the time factor is in fact a stress factor causing arisal of a state of tension.

The range of rates was selected from 1.5 to 4.5 sec, including intermediate rates of 2 and 2.5 sec; these rates corresponded (according to results of preliminary studies) to excessive (4.5 sec), limited (1.5 sec), and normal (2-2.5 sec) time.

The EEG was recorded from symmetrically located frontal and occipital regions of both hemispheres, unipolarly with the reference electrodes on the earlobes. A complex of apparatus produced by the Japanese Nihon Kohden Company was employed--a 17-channel electroencephalograph and an SDR-41 4-channel tape recorder. I recorded background and functional EEG changes occurring during activity; recording intervals were 8-10 min at each of the rates, and the recordings were made 5-6 times during the experiment. The subjects were in a shielded soundproofed, darkened room with their eyes closed, and they received the assignments indicated above by ear from a tape recorder.

The EEG data were analyzed by the spectral correlation method using a Dnepr-1 digital computer and a program described in (17); the indices employed included the coefficient of mutual correlation, the intensity of the spectral components, and coherence. A detailed mathematical description of these functions is presented in (18).

The electroencephalographic recording was fed into the digital computer on magnetic tape with a quantization frequency of 64 Hz; 4-second EEG segments in a range from 0.5 to 21 Hz were processed. Qualitative electrographic recordings were selected with the help of the computer display.

Spectral analysis of the EEG showed that different levels of brain activity associated with changes in tension at the indicated work rate are typified by a complex pattern of relationships of the intensities of frequency components in the examined delta-, theta-, alpha-, and beta-1-ranges. Comparison of the intensity spectrums of the background and functional EEG using Student's t-test showed that the largest number of differences in 100 percent of the cases occurs in the delta-, theta-, and alpha-ranges (Table 1). While in the low frequency range intensity experiences a significant increase as tension rises, the opposite law is observed in the alpha-range. Typically the highest percentage of significant differences at a high level of significance ($p \leq 0.01$) was revealed in the presence of extreme forms of tension (4.5 and 1.5 sec), while the lowest percentage was typical of intermediate forms (2-2.5 sec). Fast activity in the 14-21 Hz range increased significantly only in the presence of limited time.

In order to establish significant differences in manifestations of EEG activity I established confidence intervals for the averaged values of the intensities of the same EEG spectral components. I found that the confidence intervals for the delta-, theta-, and alpha-ranges do not overlap in the presence of too much and too little time (significance level $p \leq 0.05$); the same was noted for the beta-1-range for the 1.5 sec rate (Figure 1). The intensity of brain bioelectric activity at the 2 and 2.5 sec rates, as indicated by the intensity of beta- and theta-rhythms, does not differ significantly from background, while the alpha- and delta-intensities are quantitatively close to background indices.

The correlational and coherent relationships of EEG recorded from frontal and occipital brain regions using "forehead-forehead," "occiput-occiput" (interhemispheric relationships) and "forehead-occiput" (interhemispheric cross relationships) points of contact were found to be no less informative. Mutual correlations were found to be most highly pronounced with interhemispheric points of contact (Table 2): The highest correlations were observed for the frontal (0.85) and occipital (0.679) regions of the brain. As Table 2 shows, these correlations change little. Significant changes are observed in the "forehead-occiput" interhemispheric

Table 1. Relationship of Spectral EEG Components During Activity and in Background Conditions.

(1) Темпы деятельности, с	(2) Достоверные различия из 100% случаев, %			
	(3) дельта (4) тета (5) бета-1 (увеличение)(6)			альфа (снижение)(7)
4,5	50,3*	32*	—	10*
		15**		
2,5	33,1*	—	—	49*
2,0	16,0*	—	—	17*
1,5	50,1*	20*	49*	67*
	33,2**	18**		33**

*Data for which difference from background is at significance level $p \leq 0.05$.
**The same at $p \leq 0.01$.

Key:

1. Activity rate, sec
2. Significant differences in 100% of cases, %
3. Delta
4. Theta
5. Beta-1
6. (Increase)
7. Alpha (decrease)

relationships of both hemispheres in response to growth in tension. Thus at the 1.5 sec rate the correlations approximately double. The nature of correlations at the 4.5 sec rate does not differ from the background figures. Correlations at the 2 and 2.5 sec rates are higher than for the 4.5 sec rate, but they are lower than for the 1.5 sec rate, and they are basically significantly different from background figures.

The results of coherent analysis are presented in Figure 2 in the form of histograms plotted on the principle of comparing pairs of cortical potentials during operational mental activity and in background conditions. These potentials reflect changes in coherent relationships above background level. While it demonstrates decreases and increases in coherence, the diagram does not provide information on the actual coherence values, which are distributed as follows: The highest relationships are noted with the frontal and occipital points of contact at the delta-, theta-, and alpha-frequencies (from 0.81 to 0.57), and moderate relationships are noted for the beta-1-range (0.6 to 0.48). Intrahemispheric and interhemispheric cross relationships exhibit a rather low difference (from 0.16 to 0.33), but they are precisely the ones which indicate a specific response to change in activity rates.

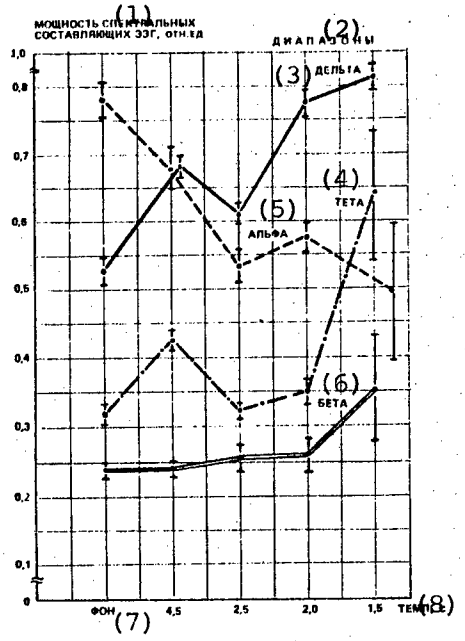

Figure 1. Graphs of Averaged Levels of EEG Spectral Densities: Confidence intervals correspond to the 95% level of significance.

Key:

1. Intensity of EEG spectral components, relative units
2. Ranges
3. Delta
4. Theta
5. Alpha
6. Beta
7. Background
8. Rate, sec

While coherence in the theta-range does not exhibit significant changes when symmetrical frontal and occipital points of contact are employed, intrahemispheric and interhemispheric cross relationships exhibit a significant "exaltation" at the extreme and transitory rates. A large increase in coherence is observed at the 4.5 sec rate for the right hemisphere. Work at the 2 sec rate did not elicit significant changes in coherence in the beta- and delta-ranges; delta-frequencies are highly coherent only with frontal and occipital points of contact at the transition of slow to fast rates. At the same time we can see a tendency toward increasing coherence in the delta-range for the 1.5 sec rate, a decrease in coherence at the slower rates, and a certain stability at the 2 sec rate.

Table 2. Levels of Cross Correlations of Brain Divisions, as Determined from EEG Data (Correlation Coefficients).*

(1) Группы отведений	(2) Фон (закрытые глаза) при $r \pm 2\sigma_r$	(3) Темпы (с) при $r \pm 2\sigma_r$			
		1,5	2	2,5	4,5
1—2**	0,743±0,0207	0,752±0,0201	0,850±0,0138*	0,778±0,0182	0,775±0,0185
1—3	0,223±0,0440	0,415±0,0383*	0,230±0,0473	0,308±0,0419*	0,288±0,0424
1—4	0,099±0,0458	0,279±0,0427*	0,148±0,0487	0,213±0,0442*	0,173±0,0449
2—3	0,122±0,0456	0,317±0,0416*	0,214±0,0476*	0,224±0,0440*	0,213±0,0442*
2—4	0,245±0,0432	0,325±0,0414	0,192±0,0481	0,371±0,0399*	0,302±0,0421
3—4	0,668±0,0256	0,427±0,0378*	0,626±0,0303	0,679±0,0249	0,643±0,0271

*Differences from background satisfy significance level $P \leq 0.05$.
**Points of contact: 1--F_3 (frontal region, left hemisphere); 2--F_4 (frontal region, right hemisphere); 3--O_1 (occipital region, left hemisphere); 4--O_2 (occipital region, right hemisphere).

Key:

1. Points of contact
2. Background (eyes closed) at $r \pm 2\sigma_r$
3. Rate (sec) at $r \pm 2\sigma_r$

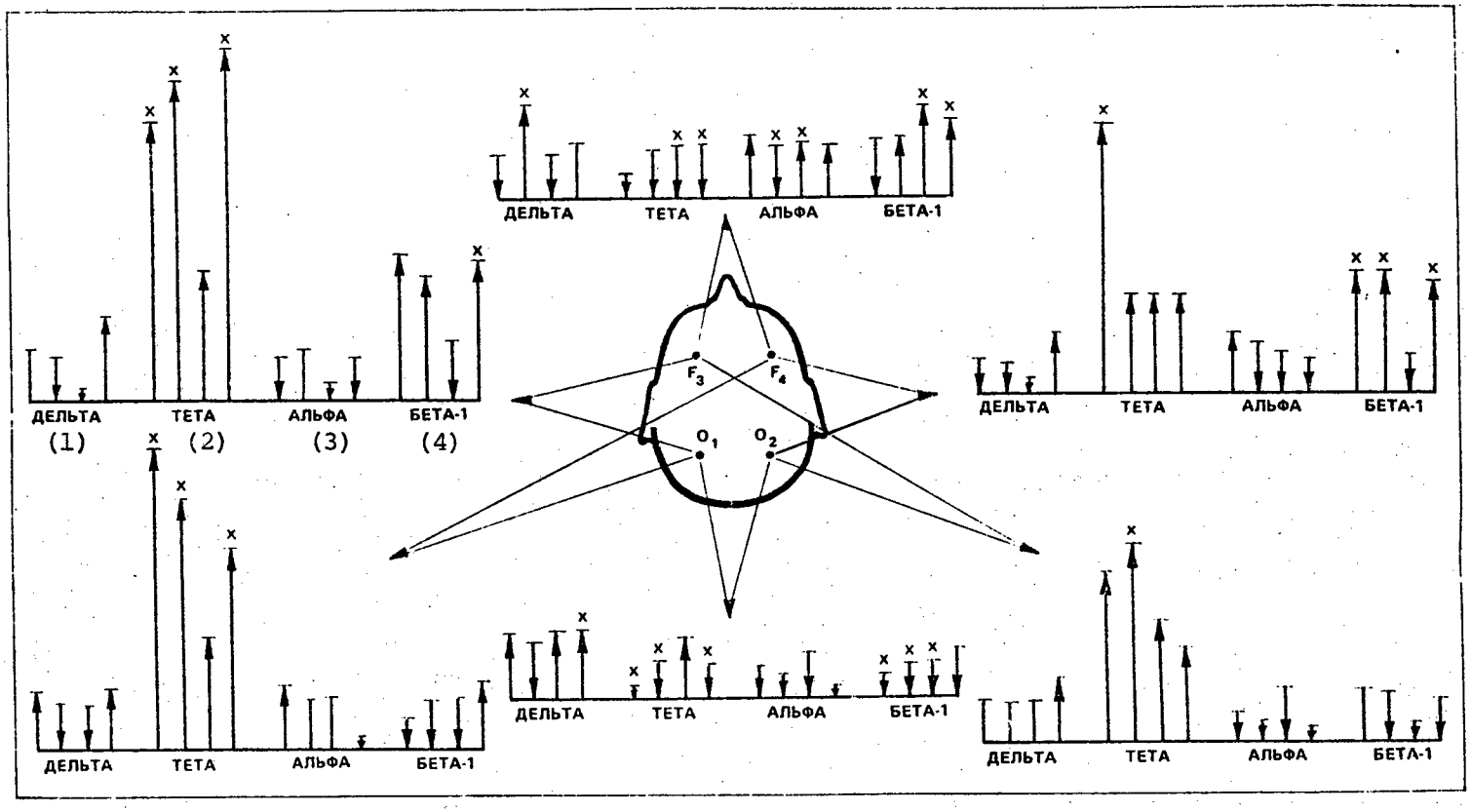

Figure 2. Histograms of Changes in Intra- and Interhemispheric Coherent Relationships Between Frontal (F_3, F_4) and Occipital (O_1, O_2) Points of Contact: The vectors at each frequency correspond to the following rates (left to right)--4.5, 2.5, 2, and 1.5 sec. Upward arrows indicate an increase above background level, downward arrows indicate a decrease below background level; X--significant differences ($p \leq 0.05$).

Key:

1. Delta
2. Theta
3. Alpha
4. Beta-1

Significant changes in coherence in the beta-1-range are observed only in relation to interhemispheric and intrahemispheric relationships: The level of the relationships increases with the fast and slow rates and declines with the intermediate rate.

The opposite tendency is observed in the alpha-range. Its coherence decreases at fast rates and grows at slow rates. However this law is not always significant. Thus Figure 2 provides an impression of the degree of change experienced by the spatial mutual relationships of EEG spectral components recorded from different brain regions in response to change in levels of tension accompanying operator mental activity.

The research showed that the EEG and the methods used to analyze it were adequate and effective for differentiated assessment of tension. Using them, I was able to confirm the hypothesis stated earlier that the state of tension accompanying operator activity is a continuum of levels of activity that changes depending on the complexity of operational mental activity (13).

The fact that the proportion of slow delta- and theta-frequencies on the EEG clearly dominated as the level of tension increased is indicative. This agrees fully with the point of view established in the literature that there is a relationship between slow bioelectric processes in the cerebral cortex and a rise in mental activity during performance of highly important assignments (19). At the same time the EEG data indicated a difference in the qualitative psychological features of different levels of attention elicited by too much and too little time. While at the 4.5 sec rate tension is elicited by anticipation, by "alert anticipatory motionlessness" (A. A. Ukhtomskiy), by an effort to retain current information in the memory, at the 1.5 sec rate it is associated with the intensity of mental actions. These levels of tension exhibit differences in the encephalogram. Thus tension in the presence of too much time elicits a rise in intensity of just the slow rhythms, while in the presence of too little time the latter increase is simultaneously accompanied by an increase in the intensity of fast activity.

The level of tension elicited by the normal rate (2 sec) is characterized by moderate changes in spectral density or intensity, in the spectral components of the EEG, while the degree of their spatial mutual association in a sense becomes equalized: The expressiveness of slow frequency ranges declines while that of fast frequency ranges grows.

Consequently we can believe that an increase in tension is accompanied by a high level of association between functionally different regions of the brain in the delta- and theta-frequency ranges, and that on the other hand a decline in tension is characterized by a decrease in these associations and their growth in the alpha-range.

Changes of two types occur in the cerebral cortex of an individual working actively: Nonspecific--a general increase in the mutual correlations of electric activity, and specific--a retuning reflecting the specific features of functional interaction typical of the current work (17). From this standpoint intrahemispheric and interhemispheric cross relationships were found to be the most informative. The frontal-occipital associations of the left hemisphere were found to be the most sensitive to change in levels of tension, reflecting specific alterations of bioelectric activity.

We can assume from this multiple spectral correlation analysis of the EEG that the EEG method is adequate to differential assessment of levels of tension. Use of this method permitted me to:

1) Reveal the most informative EEG spectral characteristics from the standpoint of an indicator of changes in levels of tension;

2) determine functional relationships among brain zones responding specifically to changes in the temporal conditions of activity;

3) acquire a dependable experimental resource for differentiated quantitative assessment of levels of tension in operational mental activity.

BIBLIOGRAPHY

1. Chaynova, L. D., "The Problem of Functional Comfort," TEKHNICHESKAYA ESTETIKA, No 12, 1975.

2. Khachatur'yants, L. S., Grimak, L. P., and Khrunov, Ye. V., "Eksperimental'naya psikhologiya v kosmicheskikh issledovaniyakh" (Experimental Psychology in Space Research), Moscow, Izd-vo Nauka, 1976.

3. Leonova, A. B., "The Problem of Subjective Assessment of Tiring," TEKHNICHESKAYA ESTETIKA, No 9, 1977.

4. Zinchenko, V. P., Leonova, A. B., and Strelkov, Yu. K., "Psikhometrika utomleniya" (The Psychometrics of Tiring), Izd-vo MGU, 1977.

5. Zimkina, A. M., and Loskutova, T. D., "The Conception of the Functional State of the Central Nervous System," FIZIOLOGIYA CHELOVEKA, Vol 2, No 2, 1976.

6. Sokolov, Ye. N., Danilova, N. N., and Khomskaya, Ye. D. (editors), "Funktsional'noye sostoyaniye mozga" (Brain Functional State), Izd-vo MGU, 1975.

7. Bartenwerfer, H., "Einige praktische Konsequenzen aus der Aktivierungstheorie," ZEITSCHRIFT FUR EXPERIMENTELLE UND ANGEWANDTE PSYCHOLOGIE, Vol 16, No 2, 1969, pp 195-222.

8. Tikhomirov, O. K., "Struktura myslitel'noy deyatel'nosti cheloveka" (The Structure of Human Mental Activity), Izd-vo MGU, 1969, p 287.

9. Munipov, V. M., "The Present State of and Trends in Development of Ergonomics and Engineering Psychology," VOPROSY PSIKHOLOGII, No 1, 1978.

10. Nayenko, N. I., "Psikhicheskaya napryazhennost'" (Mental Tension), Izd-vo MGU, 1976.

11. Marishchuk, V. L., Platonov, K. K., and Pletnitskiy, Ye. M., "Napryazhennost' v polete" (Tension in Flight), Moscow, Voyenizdat, 1969.

12. Medvedev, V. I., "Operator Functional State," in "Vvedeniye v ergonomiku" (Introduction to Ergonomics), Moscow, Izd-vo Sovetskoye Radio, 1974.

13. Chaynova, L. D., Levshinova, Zh. V., and Kashirina, L. V., "The Importance of Differentiated Assessment of States of Tension," in "Problemy funktsional'nogo komforta" (Problems of Functional Comfort), VNIITE, Moscow, 1977.

14. Blok, V., "Levels of Wakefulness and Attention," in "Eksperimental'naya psikhologiya" (Experimental Psychology), Issue 3, Moscow, Izd-vo Progress, 1970.

15. Livanov, M. N., "Prostranstvennaya organizatsiya protsessov golovnogo mozga" (Spatial Organization of Brain Processes), Moscow, Izd-vo Nauka, 1972.

16. Ioseliani, K. K., "A Technique for Studying Operator Sensomotor Activity During Perception of Stimuli in a Wide Visual Field," KOSMICHESKAYA BIOLOGIYA I MEDITSINA, No 1, 1971.

17. Trush, V. D., and Livanov, M. N., "Assessment of the Functional Significance of Bioelectric Indices Using a Master Digital Computer," in "Statisticheskaya elektrofiziologiya" (Statistical Electrophysiology), Part 1, Vil'nyus, 1968.

18. Trush, V. D., "Mathematical Methods for Analyzing Brain Electric Activity," in "Trudy VNIITE. Ergonomika" (Works of the All-Union Scientific Research Institute of Technical Esthetics. Ergonomics), Issue 13, Moscow, 1977, pp 13-24.

19. Klochkov, A. M., Yelkin, P. N., and Zheleznyakov, V. D., "Investigation of the Spectral Characteristics of the EEG and its Derivative in the Practice of Aviation Physiology," ZHURNAL VYSSHEY NERVNOY DEYATEL'NOSTI, Vol 21, No 2, 1971, pp 56-565.

11004
CSO: 1870

PHYSIOLOGY

UDC 612.82

ANALYSIS OF INTERSTRUCTURAL CEREBRAL CONNECTIONS BY THE METHOD OF BIOREGULATED MICROPOLARIZATION

Leningrad FIZIOLOGICHESKIY ZHURNAL in Russian No 4, 1978 received 28 Jul 77 pp 417-424

/Article by Yu. A. Blank, G. V. Gal'dinov and S. G. Tsikunov, Laboratory of Physiological Mechanisms of Memory Control (G. A. Vartanyan) of the Institute of Experimental Medicine of the USSR Academy of Medical Sciences, Leningrad/

/Text/ Elements of the cerebral self-regulating system were studied in chronic experiments on cats under conditions of a controlled experiment--automatic regulation of polarizing current depending on EEG changes. The effectiveness of this method for a directed effect on the functional state of regulatory structures was shown. This was manifested in long-term shifts of the theta-rhythm, in a change of excitability and in readjustments of evoked potentials. The existence of three types of connections between the temporal cortex and a number of cerebral modulating structures--rigid (positive and negative) and flexible--was revealed. Acceleration of active inhibition with extinction of the orienting response under the effect of bioregulated micropolarization of the temporal cortex and hypothalamus was attained.

Key words: micropolarization and bioregulation.

The urgency of the study of reorganization of the functional state of cerebral structures and interstructural connections is determined by the fact that they form the basis for the integrative activity of the central nervous system and, in particular, are connected with the regulation of the memory function /2-4/. The possibility of a directed modulation of the activity of a number of deep cerebral structures meets the practical tasks in the treatment of a number of diseases of the nervous system /2, 3/.

The possibility of modulation by means of intracerebral micropolarization of the functional state of cerebral formations and memory processes has been shown in the last few years /7, 8/. It was assumed that the application of the principle of biocontrolled experiment /1, 11/ in intracerebral micropolarization could expand the possibilities of studying modulating processes in the central nervous system. The task of this study also includes the determination of the functional states of a number of cerebral structures, in whose micropolarization a change in the memory function is observed.

Methods

The experiments were conducted on 10 adult cats with chronically implanted electrodes according to the previously described methods /7/.

Electrodes were placed in the temporal cortex on the basis of visual orientation with respect to the location of fissures seen through a trepanation 8 mm in diameter. According to the stereotaxic coordinates (A, L, H) of the brain atlas /14/, electrodes were inserted in the following deep cerebral structures: centrum medianum (7, 3, -0.5), caudate nucleus (15, 3), pale globe (14, 7.5, -2.5), putamen (12, 11, -2.5), reticular nuclei of the thalamus (13, 3, 0), cushion (6.5, 6, 3), mesencephalic reticular formation (3, 3.5, -3), hypothalamus (10.5, 1, -6) and hippocampus (3, 6, 5). The same stainless steel electrodes 0.25 mm in diameter with a surface of the uninsulated tip of about 0.4 mm^2 were used for micropolarization and the tapping of biopotentials. Both bipolar and unipolar anode and cathode polarization was used (a screw in the bone of the frontal sinus served as an indifferent electrode).

The principle of biocontrolled experiment was used for the regulation of the intensity of micropolarization effect depending on the dynamics of the wave activity of cerebral structures. Bioregulated micropolarization was carried out by means of an apparatus complex including the following: an Orion encephalograph, a frequency analyzer of the Nihon Firm, MH-7M and MH-10M analog computers and an electronic polarizer. The following were performed during an EEG express analysis: 1) detection of the theta rhythm; 2) nonlinear transformation of the current amplitude value according to the algorithm K ($1st^{-x}$) for the purpose of reducing the effect of high amplitude components, x--current amplitude of the theta rhythm, K--amplification factor; 3) subsequent derivation of integral values in 30 s, which served as the informative parameter. Bioregulated micropolarization was turned on after the determination of the initial level of polarizing current (base current) producing a shift of the informative parameters from the background values, which were taken as zero values, and the selection of the range of its permissible deviations. Polarizing current was regulated directly or in inverse proportion (positive or negative feedback) to the deviation of the informative parameter from the given range, which was the controlling signal (fig. 1). The prescribed feedback coefficient was defined as the ratio of the increase in

the base current to the value of the controlling signal. The statistical significance of the differences among the average values of informative parameters under different experimental conditions was evaluated according to Student's criterion and was equal to $p \leqslant 0.05$.

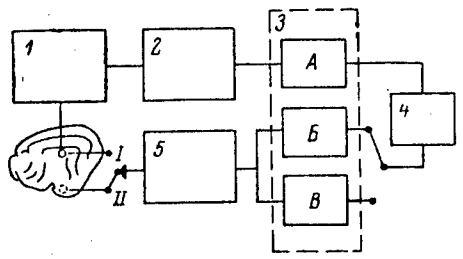

Fig. 1. Block Diagram of the System of Bioregulated Micropolarization

1--encephalograph; 2--frequency analyzer; 3--analog computer; A--block for the processing of current amplitude of the theta rhythm according to a particular algorithm; Б--block for the realization of positive and B--negative feedback; 4--memory block; 5--electronic polarizer. I--variant of focal bioregulated micropolarization, II--variant of distant bioregulated micropolarization.

Comprehensive testing of the functional state of cerebral structures before and after bioregulated micropolarization according to the following indicators was used: intensity of the theta rhythm, averaged evoked potential, thresholds of motor responses to direct electric stimulation and orienting response.

Averaging of evoked potentials to sound clicks was performed according to 40 realizations by means of the NTA-512B multichannel analyzer.

Electric stimulation with unipolar pulses with a length of 1 ms, frequency of 50 per second and voltage of 0.5-15 V was performed from the Disa electric stimulator.

To reveal the orienting response, sound clicks with a volume of about 60 db above man's hearing threshold, length of 0.7 ms and recurrence of frequency from 2 to 5 per second fed by means of the Disa generator and a dynamic loudspeaker located above the animals' heads were used. Two or three experiments on the detection of the orienting response were performed before the use of insulated bioregulated micropolarization. Six to eight sound stimuli with intervals of 5 to 10 min were fed in each experiment, the length of a single transmission ranging from 20 to 40 s.

In the control group of six animals the orienting response was extinguished without the use of bioregulated micropolarization. No less than eight experiments over a period of 3 to 6 months were performed on every animal.

Research Results

Two series of experiments based on different variants of the method of bioregulated micropolarization were performed.

In the first series of experiments the investigation of the stability of shifts of the functional state of the temporal cortex and centrum medianum was performed during and after focal bioregulated micropolarization, in which a change in the theta rhythm in the polarized structure automatically led to a correction of the polarizing current in the same structure (fig. 1, I).

Experiments showed that under specific conditions of focal bioregulated micropolarization the intensity of the theta rhythm of the temporal cortex and centrum medianum can be stably maintained at a high level (fig. 2, I, A). During the micropolarization of the temporal cortex with 0.1-0.15 μA current the intensity of the theta rhythm initially was increased by 30-50% from the background level. However, the changed activity was unstable and in time could return to the background values. Transition to the focal bioregulated micropolarization of the temporal cortex with negative feedback led to stabilization of the intensity of the theta rhythm at a high level (fluctuation limit ±10%) during a 40-50 min effect (fig. 2, I, A). Stabilization of the intensity of the theta rhythm in the focus of effect (fig. 2, I, A) with slightly greater current values (0.2-0.3 μA) was also observed during the focal bioregulated micropolarization of centrum medianum.

As a result of three to four focal bioregulated micropolarizations repeated after 2 or 3 days distinct stable readjustments of the functional state of polarized structures and some distant cerebral formations were noted over a period of 1 or 2 weeks of observation (fig. 2, I).

Trace reorganization in the previously polarized temporal cortex was characterized not by an increase, as during the effect, but by a decrease in the intensity of the theta rhythm at a rate of 20-40% with an increase in the amplitude of secondary components of the averaged evoked potential (fig. 2, A). Distant changes in functional activity were manifested in the following. In the caudate nucleus (fig. 2, I, 6), centrum medianum (fig. 2, I, 4) and anterior nuclei of the thalamus (fig. 2, I, 3) the intensity of theta rhythms decreased by 30-50% and in the hypothalamus and pale globe (fig. 2, I, 7, 10) it increased by 40-60% of the background level. A clear increase in the late components of averaged evoked potentials in centrum medianum (fig. 2, II, 4), as well as a change in the form and an increase in the amplitude of the evoked response in the caudate nucleus (fig. 2, II, 6), were detected. The thresholds of the motor response to direct electric stimulation were lowered to more than one-half in the pale globe, putamen and hypothalamus (fig. 2, III, 7, 9, 10).

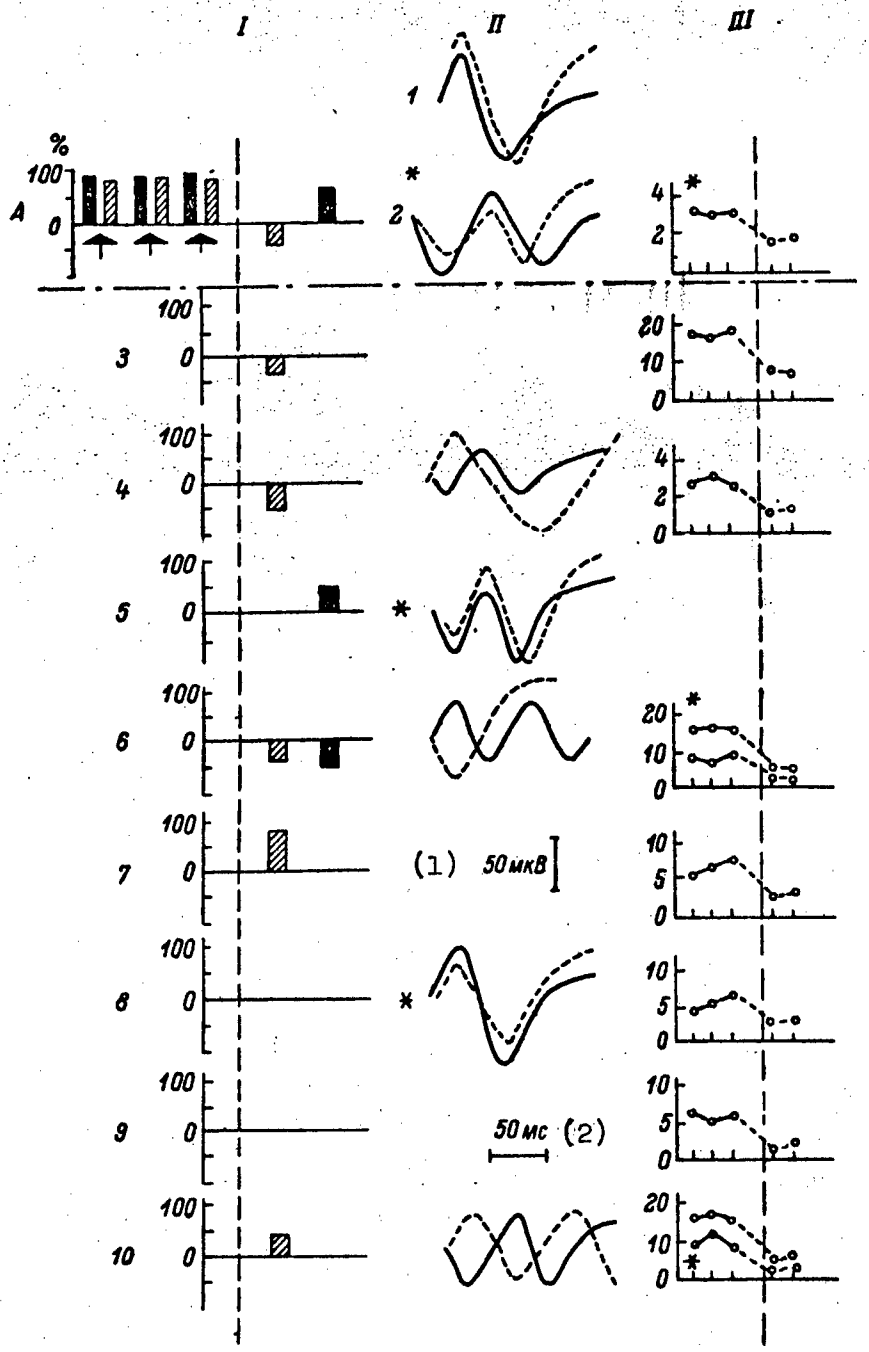

Fig. 2. Typical Changes in the Functional State of the Brain Under the Effect of Focal Bioregulated Micropolarization

Key:

1. μV

2. ms

I--shifts of the intensity of the theta rhythm (in % of the background level) during the effect (arrow) and fixed shifts. Black and cross-hatched columns--shifts in the focal bioregulated micropolarization of centrum medianum and the temporal cortex respectively. I--averaged evoked potential and III--threshold of the behavioral response to direct electric stimulation. Y-axis--stimulation voltage, in V; X-axis, experiments. Continuous and broken lines--values before and after the focal bioregulated micropolarization of the temporal cortex or centrum medianum (asterisk). 1, 5--temporal cortex; 2, 4--centrum medianum; 3--anterior nuclei of the thalamus; 6--caudate nucleus; 7--pale globe; 8--reticular nuclei of the thalamus; 9--putamen; 10--hypothalamus.

In contrast to the temporal cortex the theta activity of the previously polarized centrum medianum was stably maintained at the level recorded during the effect (40-50% above the background level), which was accompanied by a decrease in the amplitude of the early and increase in the late components of averaged evoked potentials (fig. 2, II, 2). Distant trace changes were also of a different nature. An increase in the intensity of the theta rhythm at a rate of 30-40% of the background level was noted in the temporal cortex (fig. 2, I, 5) and in the caudate nucleus theta activity was reduced by 30-50% (fig. 2, I, 6). A background level of activity was maintained in the remaining controlled structures. Inversion of the averaged evoked potential in the hypothalamus, a negligible increase in the amplitude of primary and secondary components in the temporal cortex (fig. 2, II, 5, 10) and a decrease in early and late components in the reticular nuclei of the thalamus (fig. 2, II, 8) were observed.

The characteristics of the relations between the temporal and some deep modulating structures, as well as the phenomenon of stabilization of their functional state under conditions of distant bioregulated micropolarization, were investigated in the second series of experiments. This effect differed from focal bioregulated micropolarization by the fact that the deviation from the prescribed level of the theta rhythm, in this case of the temporal cortex, was corrected automatically by means of an appropriate change in the micropolarizing current of a distant structure, not of the temporal region itself (fig. 1, II).

In distant bioregulated micropolarization of both the mesencephalic reticular formation and of the hypothalamus an increase in the intensity of the theta rhythm in the hypothalamus and an increase or decrease in the reticular formation at a rate of 50-100% were accompanied by a unidirectional change in the theta activity of the temporal cortex at a rate of 50-80% regardless of the sign of the external connection and polarity of the current, that is, there was a positive connection between the structures (fig. 3). A decrease of 50-70% in the intensity of the theta rhythm in the caudate nucleus coinciding with an increase in the theta activity of the temporal cortex was observed in distant bioregulated micropolarization of the caudate nucleus, in other words, a negative interstructural connection was manifested. Finally, the alternating

nature of connection was observed between the temporal cortex and centrum medianum in the distant bioregulated micropolarization of the latter (positive external connection). The anode effect revealed the above-mentioned positive, and the cathode effect, negative internal connection (fig. 3).

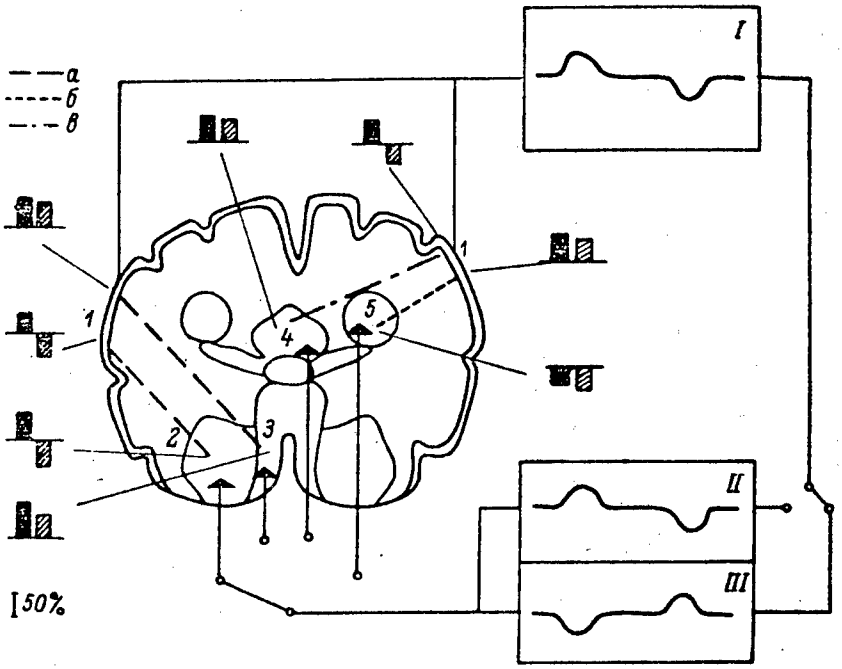

Fig. 3. EEG Manifestations of Interstructural Connections Under the Effect of Distant Bioregulated Micropolarization

а--constant positive and б--constant negative connections; в--alternating connection. Columns cross-hatched in the same way--individual variant of the shift of the theta rhythm, in % of the background level (up--increase, down--decrease). I--nature of the deviation in the intensity of the theta rhythm from the prescribed range and the appropriate correction of the current of the polarizing effect (arrow) in II--positive and III--negative feedback of distant bioregulated micropolarization. 1--temporal cortex; 2--mesencephalic reticular formation; 3--hypothalamus; 4--centrum medianum; 5--caudate nucleus.

Repetition of the effects of distant bioregulated micropolarization, as well as of focal bioregulated micropolarization, leads to the consolidation of the changes in the functional state in polarized cerebral structures and certain distant formations, which is shown in fig. 4, as exemplified by the distant bioregulated micropolarization of the hypothalamus.

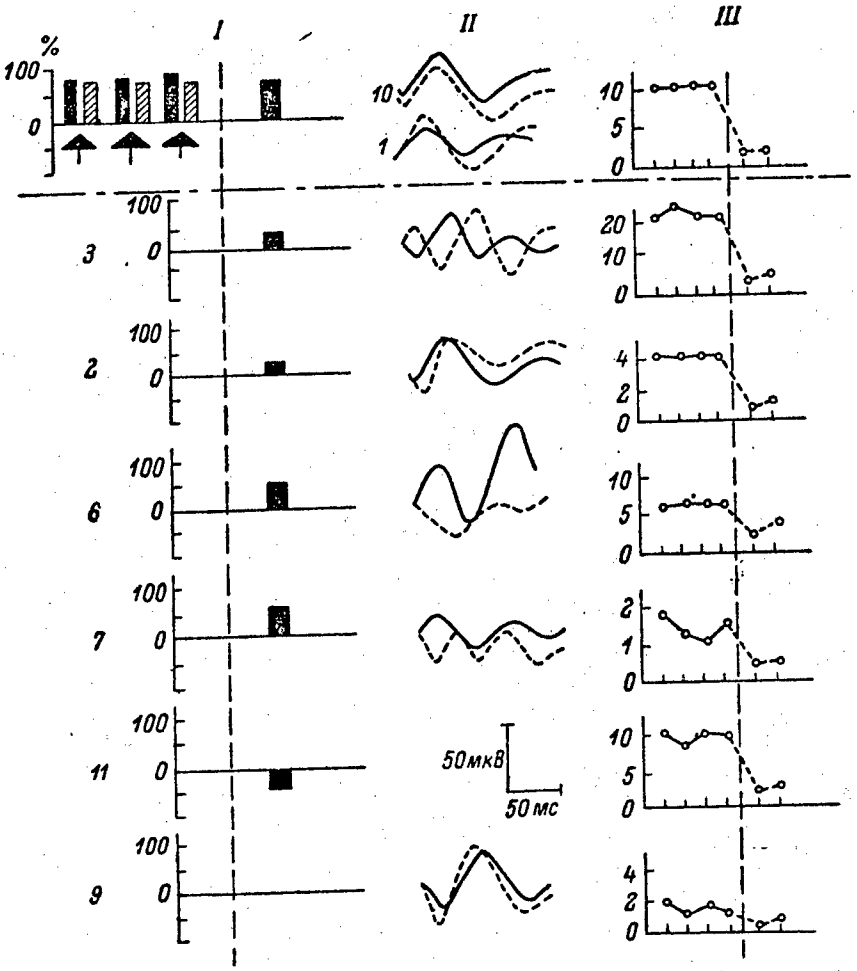

Fig. 4. Changes in the Functional State of the Brain Under the Effect of Distant Bioregulated Micropolarization

I--shifts of the intensity of the theta rhythm, in % of the background level during the distant bioregulated micropolarization of the hypothalamus according to the change in the EEG of the temporal cortex. Black columns--shifts in the hypothalamus; cross-hatched columns, in the temporal cortex. To the right--fixed shifts in polarized and distant structures. 2--cushion. The other designations are the same as in fig. 2.

The effect of functional readjustments of the temporal cortex and hypothalamus on training was investigated in a series of experiments with the orienting response. For the purpose of slowing down the extinction of the orienting response, two or three extrastimuli--sound clicks with a recurrence frequency of 70-100 per second--were fed in each experiment. The total sound transmissions in these experiments did not exceed 15-20. Then three or four experiments with insulated bioregulated micropolarization were performed,

after which the orienting response to the same stimulus parameters was tested by recording its motor and electrographic manifestations. A slowed down extinction of the orienting response sharply accelerated as a result of three or four insulated applications of focal bioregulated micropolarization of the temporal cortex or distant bioregulated micropolarization of the hypothalamus, which was manifested in the subsequent disappearance of the orienting response to the previously applied clicks with a frequency of 2, 3 and 5 per second. At the same time, the orienting response was detected to a changed stimulus with a click frequency of 100 per second (fig. 5).

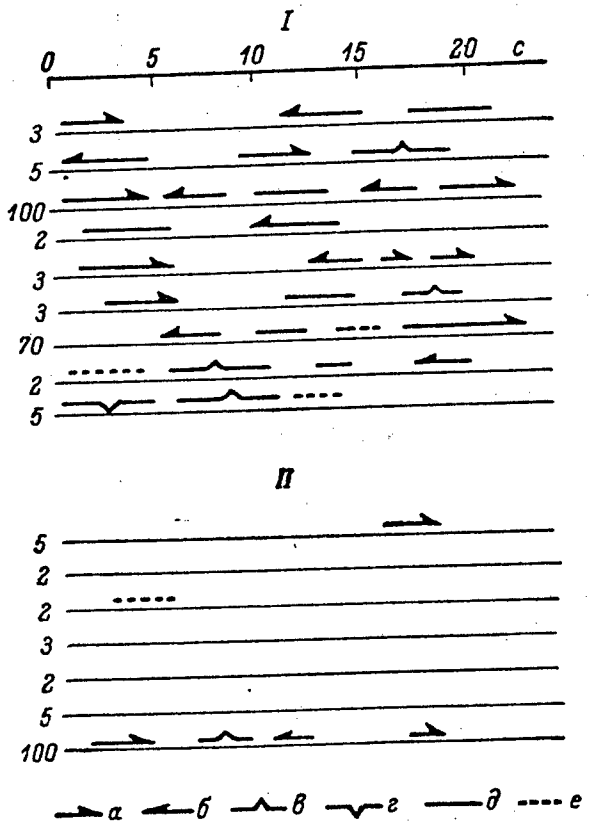

Fig. 5. Effect of Insulated Bioregulated Micropolarization on the Development of Extinction of the Orienting Response

I--behavioral manifestations of the orienting response in the second experiment before bioregulated micropolarization and II--after three experiments with bioregulated micropolarization of the hypothalamus. Above--time of effect; to the left--recurrence frequency of sound clicks per second in one transmission. а-г--head movement to the right, to the left, down and up respectively; д--general motor response; е--pronounced alertness.

Discussion of Results

The results obtained make it possible to consider bioregulated micropolarization an effective method of directed stable change in the functional state of cerebral structures and of investigation of the nature of connections among nerve centers.

As is well known, the domination of the theta rhythm in the neocortex can be connected with the facilitation of intercentral synchronization /12/ and with the intensification of the effect of emotion forming and activating structures /9/ and specific shifts of theta activity in a number of cerebral formations accompany the pathological states of the central nervous system /9/. In the experiments conducted both a stable increase in theta activity in centrum medianum and the hypothalamus and its decrease in the temporal cortex were accompanied by a reduction in the threshold of the motor response to direct electric stimulation, that is, by an increase in the excitability of these polarized centers. At the same time, shifts of the theta rhythm and an increase in excitability occurred not only in polarized formations, but in most modulating structures as well. On the basis of these data it can be concluded that certain stable readjustments of the theta rhythm of modulating structures reflected an increase in the activity of the regulatory cerebral system.

As the investigation has shown, such an increase in the activity of regulatory structures under the effect of micropolarizations can last just as long as the traces of sensory stimuli /8/, thereby manifesting similarity with a stable pathological state of the central nervous system.

At the same time, the increase in the activity of the observed structures connected with the change in the intensity of the theta rhythm has a modulating effect on the central processes of information handling. This is indicated by the results of analysis of the averaged evoked potential, which is widely used for an investigation of the effects of attention and the biological significance of a signal on perception and associative processes /10, 15/. In fact, an increase in both the early and late components of the averaged evoked potential in the auditory analyzer corresponded to the stable shifts of the theta rhythm in modulating structures. Averaged evoked potentials changed significantly in centrum medianum, in the reticular nuclei of the thalamus, in the caudate nucleus and in the hypothalamus, in the last two structures, basically in the form of an amplitude change in early and late components. It is customary to assume that the early and late complexes of responses are connected with the perception of a signal and its subsequent analysis respectively /10/. All this makes it possible to assume that the observed activation of modulating structures leads to the reorganization of the processes of primary evaluation in them and to subsequent information processing, which in turn modulates perception in the auditory analyzer.

According to the existing concept /3, 4/, psychic activity is ensured by a structural and functional system with links of a varying degree of rigidity. The use of the method of bioregulated micropolarization, in particular

distant bioregulated micropolarization, made it possible to analyze internal interstructural connections by means of control and a directed change in external feedback. It can be assumed that the constant nature of interactions following the pattern of the positive connection between the temporal cortex and the hypothalamus and reticular formation or the negative connection between the temporal cortex and the caudate nucleus forms the basis for the realization of rigid links. Evidently, alternating connections similar to those that occur in the interaction of the temporal cortex and centrum medianum under conditions of distant bioregulated micropolarization correspond to flexible links.

Finally, the fact of the effect of bioregulated micropolarization on the orienting response indicates that the reorganization of the functional activity of the structures of the controlling cerebral system /5/ is related to the modulation of memory processes. As is well known, many investigators consider the extinction of the orienting reflex a phase in training during the transition from unconditioned to conditioned reflexes connected with the processes of active inhibition in neocortical and reticular systems /6, 13/. In the present experiments bioregulated micropolarization was used only after a multiple presentation of a stimulus, but before the appearance of extinction signs. Since as a result of this the orienting response disappeared, it is obvious that bioregulated micropolarization contributed to the extraction under conditions of situational afferentation of the hidden traces of active inhibition and their accelerated consolidation.

BIBLIOGRAPHY

1. Bekhtereva, N. P., and Usov, V. V., "Method of Intermittent Photostimulation in the Rhythm of Internal Brain Potentials During the Recording of an Electroencephalogram," FIZIOL. ZH. SSSR, 1960, 46, 1, 108-111.

2. Bekhtereva, N. P., in the collection "Glubokiye Struktury Golovnogo Mozga v Norme i Patologii" /Deep Brain Structures in Health and Pathology/, Izd. Nauka, Moscow-Leningrad, 1966, 18-21.

3. Bekhtereva, N. P. (1971), "Neyrofiziologicheskiye Aspekty Psikhicheskoy Deyatel'nosti Cheloveka" /Neurophysiological Aspects of Man's Psychic Activity/, Izd. Meditsina, Leningrad, 1974, 73-134.

4. Bekhtereva, N. P., in the collection "Mekhanizmy Modulyatsii Pamyati" /Memory Modulation Mechanisms/, Izd. Nauka, Leningrad, 1976, 7-14.

5. Vartanyan, G. A., Gal'dinov, G. V., and Repin, V. S., "Experimental Approaches to the Study of Memory Control Mechanisms," FIZIOLOGIYA CHELOVEKA, 1976, 6, 1, 1010-1017.

6. Vinogradova, O. S., "Oriyentirovochnyy Refleks i Yego Neyrofiziologicheskiye Mekhanizmy" /The Orienting Reflex and Its Neurophysiological Mechanisms/, Izd. APN, Moscow, 1961, 105-159.

7. Gal'dinov, G. V., "Polarization as a Method of Investigating Long-Term Traces and Some Memory Mechanisms," FIZIOL. ZH. SSSR, 1971, 57, 6, 784-789.

8. Gal'dinov, G. V., and Danilov, N. V., "The Functional Characteristics of Motor and Temporal Cortex Regions in Cats in the Process of Formation of an Experimental Memory Model," FIZIOL. ZH. SSSR, 1972, 58, 11, 1645-1650.

9. Grindel', O. M., Dobronravova, I. S., and Dobrokhotova, T. A., in the book "Osnovnyye Problemy Elektrofiziologii Golovnogo Mozga" /Basic Problems of Brain Electrophysiology/, Izd. Nauka, Moscow, 1976, 78-110.

10. Ivanitskiy, A. M., "Mozgovyye Mekhanizmy Otsenki Signala" /Brain Mechanisms of Signal Evaluation/, Izd. Meditsina, Moscow, 1976, 78-110.

11. Livanov, M. N., Zhadin, M. N., Kreytser, G. P., and Trush, V. D., "Use of Electronic Digital Computers for Setting up a Controlled Electrophysiological Experiment," BIOFIZIKA, 1966, 11, 2, 306-313.

12. Livanov, M. N., "Prostranstvennaya Organizatsiya Protsessov Golovnogo Mozga" /Spatial Organization of Brain Processes/, Izd. Nauka, Moscow, 1972, 7-104.

13. Sokolov, Ye. N., in the collection "Oriyentirovochnyy Refleks i Voprosy Vysshey Nervnoy Deyatel'nosti" /The Orienting Reflex and Problems of Higher Nervous Activity/, Izd. APN, Moscow, 1959, 5-8.

14. Jasper, H., and Ajmone-Marsan, C., "Astereotaxic Atlas of the Diencephalon of the Cat," Ottawa, 1954.

15. Regan, O., "Evoked Potentials in Psychology, Sensory Physiology and Clinical Medicine," Chapman A. Hall Ltd., London, 1972, 25-180.

11,439
CSO: 1870

SCIENTISTS AND SCIENTIFIC ORGANIZATIONS

CONGRESS OF PHYSIOLOGICAL SOCIETY TO BE HELD IN ALMA-ATA

Leningrad FIZIOLOGICHESKIY ZHURNAL in Russian No 4, 1978 p 576

/Notification by the Organizational and Program Committees on Preparing and Holding the 13th Congress of the All-Union Physiological Society imeni I. P. Pavlov (Alma-Ata), September 1979)/

/Text/ It is advised that the congress program envisages a discussion at section meetings of scientific reports on new research devoted to the following problems of physiological science:

1. General physiology of the nervous system.
2. Patterns and mechanisms of the higher nervous activity.
3. Genetics of nervous activity and of complex forms of behavior.
4. Memory mechanisms.
5. Functions of the vegetative nervous system.
6. Evolutionary physiology and comparative physiology.
7. Age physiology.
8. Ecological physiology and adaptation problems.
9. Biorhythms.
10. Barrier functions as homeostasis regulation mechanisms.
11. Physiological cybernetics.
12. Patterns and mechanisms of perception, processing and realization of sensory information.
13. Biomechanics (organization and control of movements).

14. Mechanisms of formation and perception of speech.

15. Patterns and mechanisms of relations between the brain and internal organs.

16. General physiology of visceral systems.

17. Patterns and mechanisms of the activity of the cardiovascular system.

18. Patterns and mechanisms of the activity of the respiratory system.

19. Patterns and mechanisms of the activity of the digestive and absorbing system.

20. Patterns and mechanisms of the activity of kidneys and the water-salt metabolism.

21. Mechanisms of the activity of the blood system.

22. Patterns and mechanisms of the activity of the endocrine system.

23. Bioenergetics.

24. Principles and mechanisms of activity of the healthy and sick human brain.

25. Physiology of labor activity.

26. Physiology of sports activity.

27. Space and underwater physiology.

28. Physiology of farm animals.

29. History and theory of the development of physiological science.

30. Information support for physiological research.

The abstracts of scientific reports will by accepted by the program committee of this congress solely from republic (for the RSFSR, from city) departments of the All-Union Physiological Society. As a rule, only the members of the All-Union Physiological Society can be the authors of scientific reports submitted for the congress. Papers sent to the program committee without an appropriate presentation by a republic (or city) department of this society will not be considered.

15 July 1978 is the final date for the acceptance of abstracts. Papers received by the program committee after this date will be returned to addresees without consideration.

Abstracts should be sent to the program committee to the following address: 199164 Leningrad, nab. Makarova, 6, Institut Fiziologii im. I. P. Pavlova AN SSSR /Institute of Physiology imeni I. P. Pavlov of the USSR Academy of Sciences/.

11,439
CSO: 1870

END